A blind, new species of *Diancistrus* (Teleostei, Bythitidae) from three caves on Muna Island, southeast of Sulawesi, Indonesia

by

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ABSTRACT. - A new species, *Diancistrus typhlops* (Ophidiiformes, Bythitidae), is described from six adult specimens (51-80 SL) caught in the dark zone in three anchialine caves on Muna Island, southeast of Sulawesi. It differs from the 27 species of *Diancistrus* hitherto described by being eyeless and by the combination of the number of dorsal fin rays and length of head. Based on the pseudoclasper morphology, the most similar species is *Diancistrus leisi* Schwarzhans, Møller & Nielsen, 2005, caught in the Coral Sea and on the Great Barrier Reef. The new species differs from *D. leisi* by the numbers of dorsal fin rays 78-81 *vs* 69-73 and anal fin rays 63-65 *vs* 55-57, and by lacking pseudobranchial filaments *vs* two filaments.

RÉSUMÉ. - Nouvelle espèce aveugle de *Diancistrus* (Teleostei, Bythitidae) provenant de trois grottes sur l'île de Muna, sud-est de Sulawesi, Indonésie.

Une nouvelle espèce, *Diancistrus typhlops* (Ophidiiformes, Bythitidae), est décrite à partir de six spécimens adultes (51-80 mm LS), récoltés dans la zone obscure de trois grottes anchialines de l'île de Muna, au sud-est de Sulawesi. Elle se distingue des 27 espèces de *Diancistrus* décrites à ce jour, par l'absence d'œil, un nombre différent de rayons à la nageoire dorsale et la longueur de la tête. L'espèce la plus proche est *Diancistrus leisi* Schwarzhans, Møller & Nielsen, 2005, récoltée en mer de Corail et sur la Grande Barrière. La nouvelle espèce diffère de *D. leisi* par le nombre de rayons à la nageoire dorsale 78-81 vs 69-73, et à la nageoire anale 63-65 *vs* 55-57, et l'absence de filaments pseudobranchiaux *vs* présence de deux filaments.

Key words. - Bythitidae - Dinematichthyini - *Diancistrus* n. sp. - ISEW - Indonesia - Blind cave species - New species.

In 2007, an international expedition lead by Dr. Louis Deharveng from the Museum national d'Histoire naturelle examined three caves on Muna Island, southeast of Sulawesi. Divers observed a number of red-coloured, eyeless fish, which were photographed and six specimens were caught. Examination of the material revealed that they belong to the family Bythitidae. Furthermore, the combination of the caudal fin not joining the dorsal and anal fins and the development of a penis and 1-2 pairs of pseudoclaspers covered by a fleshy hood, places the specimens in the tribe Dinematichthyini of the subfamily Brosmophycinae (Møller *et al.*, 2004). A key to the genera of the tribe was published by Møller and Schwarzhans (2008) and the present specimens key out to the genus *Diancistrus* Ogilby, 1899. By being eyeless it differs from all of the 27 *Diancistrus* species hitherto described (Schwarzhans *et al.*, 2005) and also the combination of head length and number of dorsal fin rays is unique.

Consequently, we consider the present material as new and describe it below. Institutional abbreviations follow Eschmeyer (1998).

DIANCISTRUS TYPHLOPS NEW SPECIES

Figs 1-3

Material examined (6 specimens, SL 51-80 mm)

Holotype. - MZB 17174 (SL 66 mm, male), Indonesia, Southeastern Sulawesi Province, Muna Island, Tongkuno district, Oempo village, Walengkabola, Alam Moko cave, 05°10'27.5''S, 122°35'0.6''E, hand net scuba diving, coll. S. Eberhard, 13 Sept. 2007.

Paratypes. - MZB 17175 (SL 78 mm, male) and ZMUC P771680 (SL 62 mm, female), same data as for holotype. - ZMUC P771681 (SL 80 mm, male), Muna Island, Tongkuno district, Oempo village, Walengkabola, Gua Moko cave, 05°10'18.0''S, 122°34'55.1''E, hand net scuba diving, coll. B.C. Vilanova, 14 Sept., 2007. - MNHN 2009-0154 (SL 69 mm, male) and ZRC 51874 (SL 51 mm, female), Muna Island, Tongkuno district, Oempo village, Walengkabola, Moko Morete cave, 05°10'18.1''S, 122°34'58.4''E, hand net scuba diving, coll. F. Brehier, 22 Sept., 2007.

Remarks to material

Three specimens were kept alive for about three days in a

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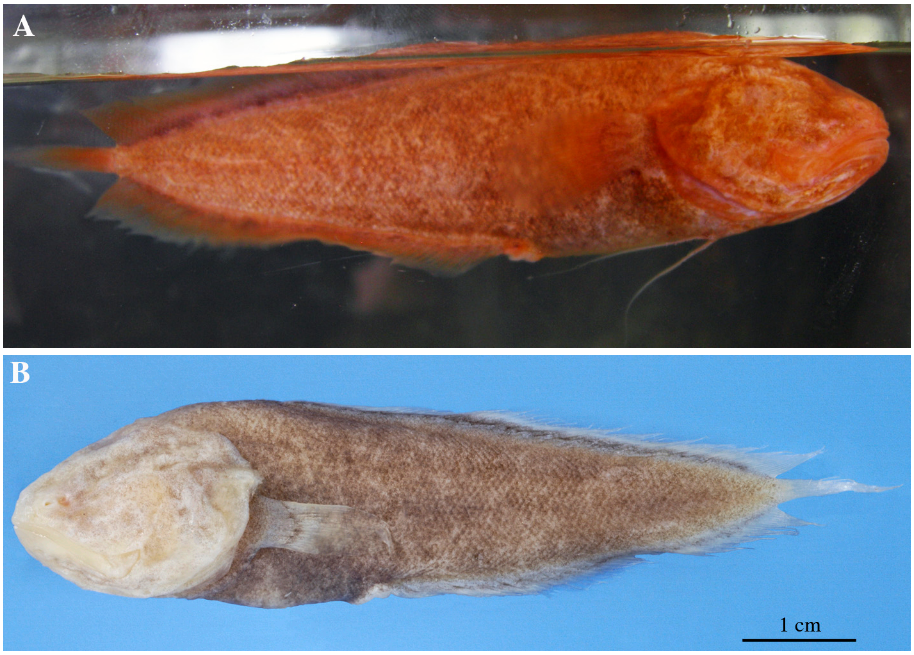

Figure 1. - *Diancistrus typhlops*, MZB 17174, holotype, SL 66 mm. **A**: Photo alive. **B**: Photo after about one year of preservation.

	Holotype MZB 17174	Holotype and 5 paratypes
Standard length	66	51-80
Meristic characters		
Dorsal fin rays	79	78 (79.3) 81
Caudal fin rays	14	13 (14.3) 15
Anal fin rays	64	63 (63.6) 65
Pectoral fin rays	18	18 (18.4) 20
Pelvic fin rays	1	1
Precaudal vertebrae	11	11 (11.2) 12
Total vertebrae	41	40 (40.8) 41
Dorsal fin origin above vertebra no.	6	6 (6.2) 7
Anal fin origin below dorsal fin ray no.	18	17 (18.0) 19
Anal fin origin below vertebra no.	14	14 (14.2) 15
Long gill rakers	3	3 (3.7) 4
Long + platelike gill rakers	18	17 (18.3) 20
Pseudobranchial filaments	0	0
Morphometric characters in % of standard length		
Head length	32.5	30.5 (32.0) 32.5
Depth at anal fin origin	23.0	20.5 (23.8) 26.0
Upper jaw length	16.5	15.0 (16.6) 17.5
Depth of posterior maxillary	5.8	5.1 (5.4) 5.8
Preanal length	51	50 (52.3) 55
Predorsal length	39.0	35.0 (37.0) 39.0
From base of pelvic to anal fin origin	25.5	22.5 (24.6) 27.0
Longest gill raker	2.0	1.8 (1.9) 2.0
Pectoral fin length	20.5	16.0 (17.7) 20.5
Pelvic fin length	18.8+	22.0 (24.6) 27.0

Table I. - Meristic and morphometric characters of *Diancistrus typhlops*.

small glass aquarium kept dark by black plastic. In the first two days the fish were active, but on the third day they became so quiet that they could be photographed. The other three specimens were preserved on capture. Several dozens specimens were observed by the divers.

Diagnosis

Diancistrus typhlops is unique within the genus by being eyeless and by the combination of dorsal fin rays (78-81) and head length (30.5-32.5%). Vertebrae 11-12 + 29-30, anal fin rays 63-65. Long gill rakers 3-4. Pseudobranchial filaments absent. Scales on cheek in a narrow patch, none on the opercle. Pointed outer pseudoclasper only slightly longer than inner pseudoclasper. The pseudoclaspers are connected anteriorly. Live colour red.

Similarity

Schwarzhans *et al*. (2005) divided the 27 species of *Diancistrus* into three species-groups according to the pseudoclasper organization and into 4 species-groups based on the head squamation. Judged by the pseudoclaspers *D. typhlops* belongs to *D. longifilis*/*springeri* species-group, which again is divided into two subgroups according to the shape of the outer pseudoclasper. The subgroup into which *D. typhlops* fits holds two species: *D. leisi* Schwarzhans, Møller & Nielsen, 2005 and *D. springeri* Schwarzhans, Møller & Nielsen, 2005. Regarding the head squamation species-groups *D. typhlops* belongs to the one characterized by being without scales on the operculum. The group holds 13 species including *D. leisi* but excluding *D. springeri*. When using the "Key to the species of *Diancistrus*" (Schwarzhans *et al.,* 2005) *D. typhlops* keys out as *D. leisi*. Consequently, it can be assumed that *D. leisi* is the species most similar to *D. typhlops*.

The two species differ from each other in the following characters (*D. leisi* in parenthesis): Eyes not externally visible (eyes 1.7% SL), dorsal fin rays 78-81 (69-73), anal fin rays 63-65 (55-57), pseudobranchial filaments 0 (2) and sagitta with prominent, angular concavity anteriorly in dorsal rim (no prominent concavity).

Description (of holotype; differences in paratypes are mentioned in parenthesis)

The principal meristic and morphometric characters are shown in table I. Robust, compressed body and depressed head with blunt snout. Body covered with small (1 mm, 1.5% SL), circular, overlapping scales, which continue onto proximal part of dorsal and anal fins. Lateral line indistinct. Head with scale patch on cheek, five scales broad on upper cheek, one in the middle and four scales broad on lower cheek. No scales on operculum (Fig. 2A). Dorsal fin origin above base of pectorals. Anal origin at mid-body. Pelvic fin rays broken (reaching or almost reaching anal fin origin). Pectoral fins in midline of body. Eyes not visible externally. A reddish area almost 1 mm in diameter just behind posterior nostril most probably indicating position of lost eye (less distinct or not present). Anterior nostril with well developed tube placed low on snout. Posterior nostril with low rim twice the size of anterior nostril. Maxillary ends far behind position of lost eye, posterior part vertically expanded. Operculum with sharp spine partly covered by skin. Anterior gill arch with four (4-5) short rakers on upper branch and lower branch with three (3-4) long and 11 (9-12) short rakers. Lower of long rakers twice as broad and somewhat longer than upper two (1-2 broad and longer rakers). About 60 gill filaments each with a dark line on stem. Pseudobranchial filaments lacking.

Head pores (Fig. 2A-B). - Supraorbital pores 2: 1st at tip of snout, 2nd above opercular spine; infraorbital pores 6 (3 anterior and 3 posterior): 1st anterior pore behind anterior nostril, 2nd and 3rd anterior pores covered by dermal flap of upper lip, 3 posterior pores on rear part of upper lip, last tubular; mandibular pores 6 (3 anterior and 3 posterior): 1st anterior pore small placed at tip of lower jaw, 2nd anterior pore positioned in lateral skin fold, 3rd anterior at anterior termination of jugular isthmus, 3 posterior pores on rear part of lower jaw; preopercular pores 4 (3 lower and 1 upper): 1st and 2nd lower pores with joint openings, 3rd pore just above, tubular, upper preopercular pore behind and above cheek scale patch, tubular, missing on one side in one specimen.

Dentition. - Dentaries with about 15 retrorse fangs in inner row and small, pointed teeth in irregular outer rows decreasing in number posteriorad. Premaxillaries with 1-2 large fangs near symphysis, inner row with about 10 small fangs on anterior third of premaxillary, outer rows irregular with small, blunt teeth. Palatines with small, fang-like teeth in three rows anteriorly decreasing to two rows posteriorly. Vomer boomerang-shaped and with 2-3 rows of small, pointed teeth anteriorly and one row of 5-10 fangs in a posterior row.

Otolith (Fig. 3). - The sagittal otolith is moderately elongate with sharply pointed anterior tip and broad, dorsally projecting posterior tip, dorsal rim with angular concavity above anterior of tip of sulcus and prominent, rounded middorsal portion. Length of sagitta 1.8-1.9 times height and 1.9-2.0 times length of undivided sulcus.

Axial skeleton (from radiographs). - Anterior five neural spines pointed. First neural spine half length of 2nd spine. Neural spines number 6-10 (6-8, 9, 11) shorter, somewhat depressed and with blunt tips. Broad bases of neural spines number 6-10 (5, 6-7, 8, 9,10). Remaining neural and all haemal spines all pointed. Broad parapophyses on vertebrae 7-11 increasing in length posteriorad. Pleural ribs on vertebrae 2-10 (2, 3-10,11). Epipleural ribs indistinct.

Male copulatory organ (Fig. 2C-E). - Two pairs of moderately large pseudoclaspers. Pointed outer pseudoclasper only slightly longer than inner pseudoclasper, connected to

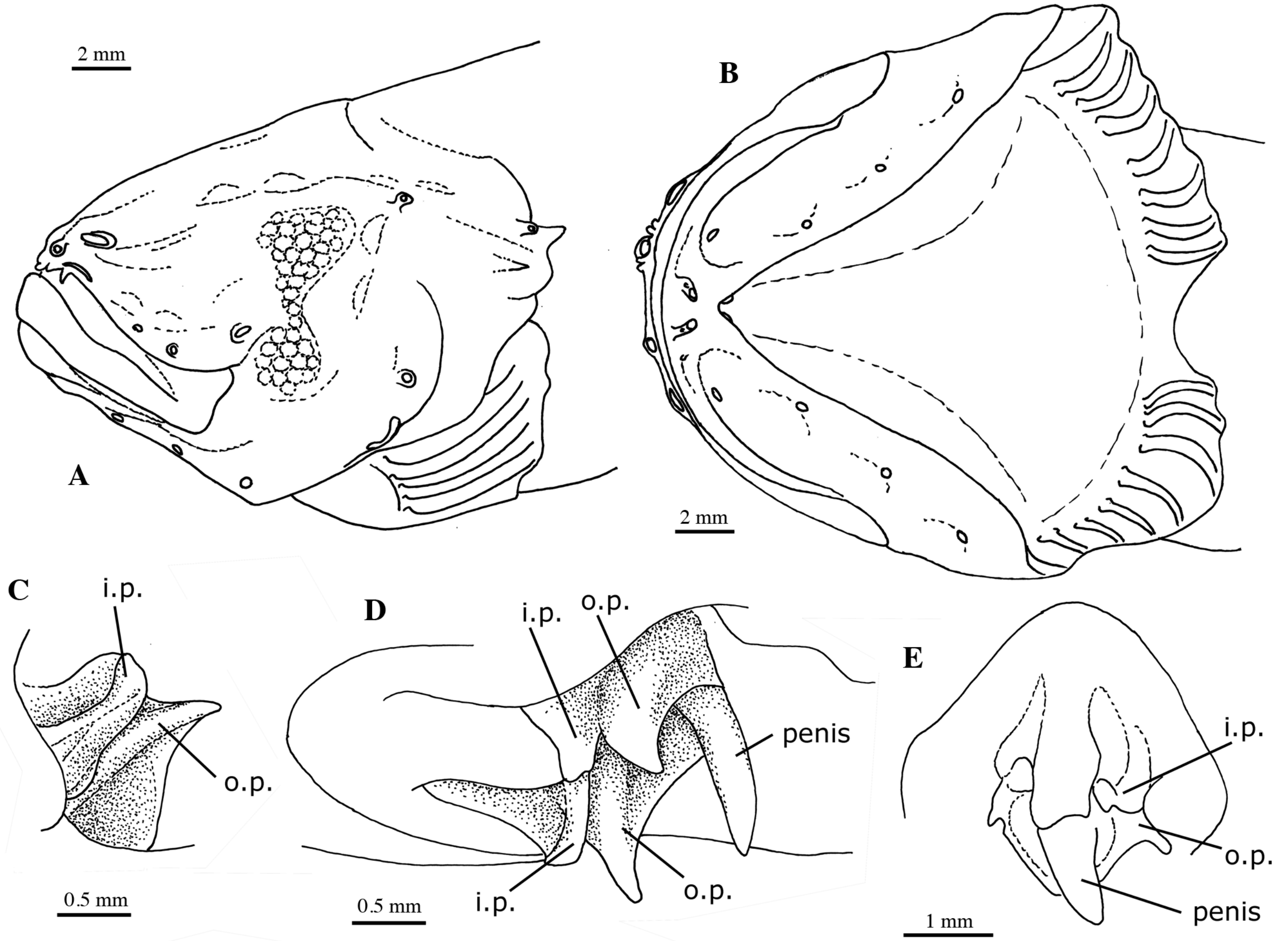

Figure 2. - *Diancistrus typhlops*, ZMUC P771681, paratype, SL 80 mm. **A**: Lateral view of head. **B**: Ventral view of head. **C**: View of left pseudoclasper from inside. **D**: Inclined lateral view of copulatory organ. **E**: Ventral view of copulatory organ. i.p. (inner pseudoclasper), o.p. (outer pseudoclasper).

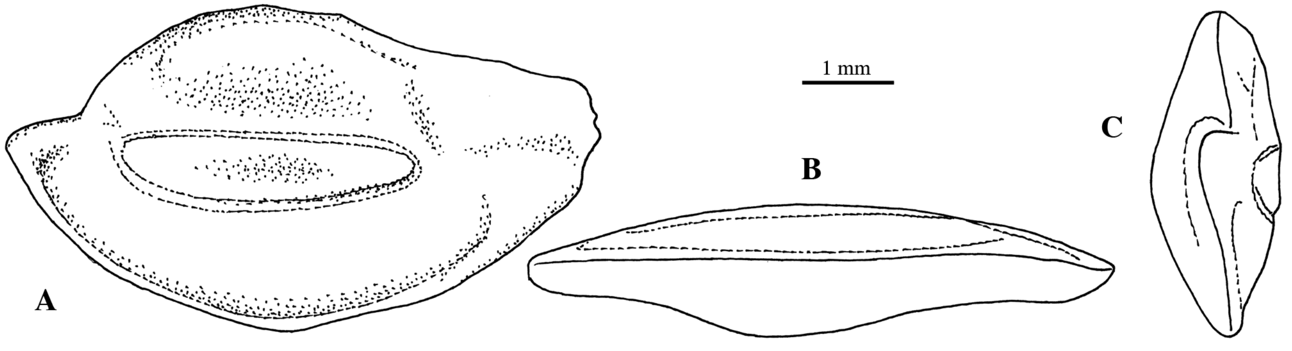

Figure 3. - *Diancistrus typhlops*, MZB17175, paratype, SL 78 mm, ♂, right sagittal otolith. **A**: Median view. **B**: Anterior view. **C**: Ventral view.

each other anteriorly by a thin ligament. Inner pseudoclasper narrow, stick-like and slightly forwardly inclined, anteriorly connected by a thin ligament to wide isthmus between pseudoclaspers. Penis short and thin.

Coloration. - Photographs of live specimens show that the entire fish is dark-red with the margin of the dorsal, caudal and anal fins transparent and the base of the dorsal and anal fins blackish (Fig. 1A). After one year in ethanol all red has disappeared, the head is light, the body is light brown and the bases of the dorsal and anal fins are dark (Fig. 1B).

Biology

Diancistrus typhlops belongs to a viviparous family. Recently, however, a rare instance has been observed within the Dinematichthyini, where viviparity appears doubtful (*Didymothallus criniceps* Schwarzhans & Møller, 2007), and it is also not proven for *D. typhlops*. The two females have eggs up to 0.8 mm in diameter, but no embryos were found. The 62 mm SL female had about 250 eggs 0.6-0.8 mm in diameter. The four males have a well-developed intromittent organ and histological sections of the testes of one of these (MNHN 2009-0154) show numerous spermatophores in the testicular duct. The presence of long, retrorse fangs indicates that they can take relatively large prey. The only identifiable stomach content, judged from radiographs, is two 2 mm long gastropods. The absence of eyes indicates that the species has evolved under dark cave conditions.

The specimens were easily caught in hand nets. They kept close to the rocks often upside down. In Moko Morete an interesting nocturnal migration was observed as dozens of fish from the lightless parts of the cave appeared in the blue hole after dark. There was much more food available in the blue hole than in the oligotrophic cave habitat as the blue hole was exposed to daylight all day long. It was not without risk to stay in the blue hole as many specimens were eaten by snakes.

Except for some possibly introduced marine fish in the Alam Moko blue hole the only fish found in the caves was *Diancistrus typhlops*. A number of crustaceans were observed and caught in traps: Copepoda (Harpacticoida - *Tisbe*?, Cyclopoida - Oithonidae), Amphipoda (Melitidae - *Grandidiereli* sp.) and Decapoda (Natantia).

The salinity in the caves varied between 5-10 ppm in the surface layers and about 30 ppm in the bottom layers with a sharp halocline at 15-20 m depth.

Description of the caves

The Alam Moko, Gua Moko and Moko Morete are anchialine caves with an upper layer of fresh to weakly brackish water above layers of saltwater. Sharp picnoclines were observed, especially in Moko Morete, the longer of the caves. Passages develop towards the sea, located 400-500 m to the east. Fresh water flows into the sea through springs that we succeeded to locate and partly explore (Franck Brehier, pers. com.). In Moko Morete a strong tidal flow causes an inflow of saltwater.

Alam Moko is a vast blue hole close to 30 m in diameter with direct exposure to daylight, surrounded by cliffs up to 6 m high. One passage develops to the west, but it is too narrow to allow the passage of a diver. The main passage develops to the east. It is in complete darkness, 16.5 m deep and about 65 m long ending in a collapse of stones.

Moko Morete opens in a vast blue hole. An underwater passage to the west can be followed 10 to 15 m, but then it becomes too narrow. It may lead to Gua Moko. The main passage begins to the east. With 403 m, it is one of the longest sumps explored on Muna so far. The maximum depth is 21 m. The inner part is huge, ending in a collapse due to the very soft nature of the limestone. The cave still needs to be thoroughly explored. Only the few first meters are exposed to daylight.

Gua Moko begins with a dry passage that leads to a lake about 50 m long. The sump begins thus in total darkness, is 43 m long and 14 m in depth. The cave is 116 m and completely lightless.

Distribution

Known from three caves at Muna Island southeast of Sulawesi: Alam Moko (all along the passage), Gua Moko (a few specimens), and Moko Morete (at least as far as the main chamber).

Etymology

The specific name, *typhlops*, means blind.

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